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Wrap-Up Report for 2018 Seoul Bioethanol Conference

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Biofuels

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Report Highlights:

On June 26, 2018, the Agricultural Affairs Office at U.S. Embassy Seoul, the U.S. Grains Council Korea office and the Korea Biofuels Forum jointly hosted the 2018 Seoul Bioethanol Conference. Conference speakers provided information on the U.S. experience with ethanol and also updated attendees on Korea and China's biofuels situation. The Korean government currently bans the use of ethanol as a transportation fuel but the government is nearing completion of a feasibility study looking into potential blend ratios.

General Information:

For the past three years, FAS Seoul and the U.S. Grains Council Korea office have hosted an ethanol conference to explain the environmental, human health, energy security, and economic benefits for Korea of blending ethanol into the gasoline supply. On June 26th, FAS Seoul, U.S. Grains Council Korea office and the Korea Biofuels Forum jointly hosted the third and largest iteration of this conference. Despite acknowledged air quality issues in urban centers, Korea currently disallows the use of ethanol as a transportation fuel. The Korean government is nearing completion of a feasibility study looking into potential blend ratios. FAS Seoul is optimistic that Korea will soon join its neighbors China and Japan in adopting an ethanol fuel policy.

The 2018 conference featured the following speakers and presentations:

1. U.S. and the Global Ethanol Market – Policy with A Role for Trade and Collaboration
- **Mr. Daniel Whitley**
2. The Impact of Higher Ethanol Blend Levels on Vehicle Emissions in Five Global Cities - - **Dr. Steffen Mueller**
3. Clean Air Choice, Improving The Air We Breathe - **Ms. Angela Tin**
4. The United States Experience in Using Ethanol Fuels to Meet Clean Air Act Goals
- **Mr. John Mooney**
5. Biofuels and Fine Dust in Korea - **Dr. Bae, Jeong-Hwan**
6. Growing Global Ethanol Use – Four factors driving production, consumption and trade - **Mr. Brian Healy**
7. China's Fuel Ethanol Development, Policy and 2020 E-10 Promotion Plan
- **Mr. Michael Mao**
8. U.S. Bioethanol Policy and Market Experience - **Mr. James Miller**
9. Prospect for Market Expansion of Bioethanol In Korea - **Dr. Sang, Byoung-In**

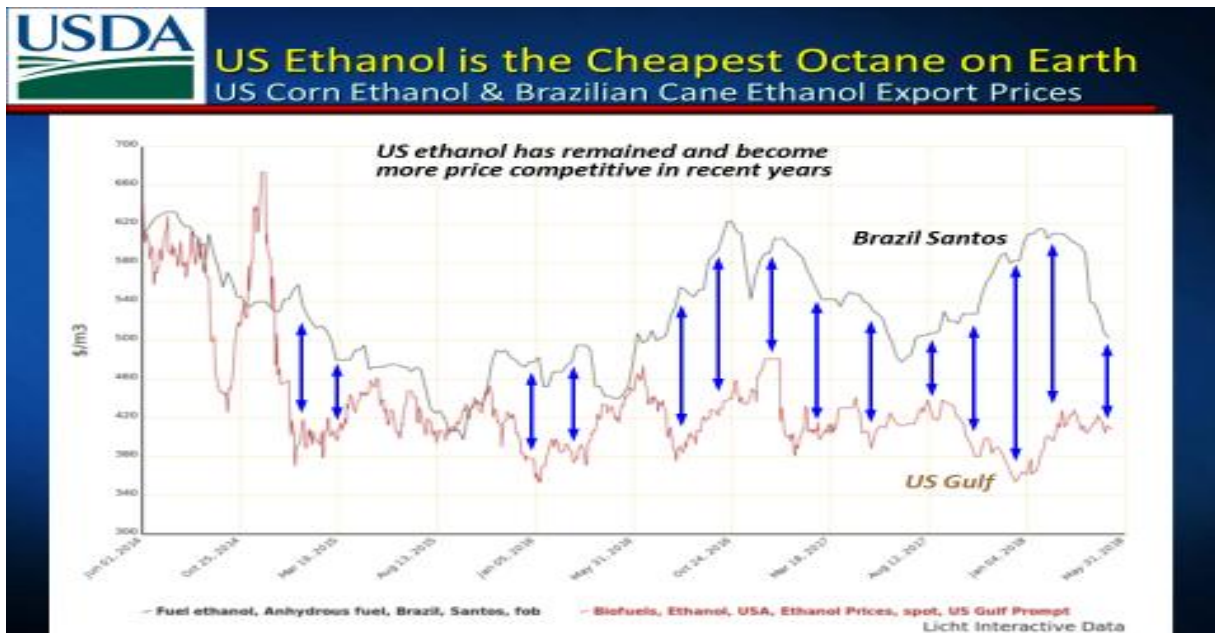
Workshop presentations and summaries:

Presentation#1: The U.S. and the Global Ethanol Market - Policy with a Role for Trade

Daniel Whitley, Associate Administrator, Foreign Agricultural Service, USDA

The U.S. ethanol program has been successful and is an example of the way USDA partners with the private sector to develop good public policy. Given the improvements to date in the efficiency of U.S.

ethanol production, compared to conventional gasoline, ethanol is expected to produce 50 percent less greenhouse gas emissions by 2020. Over the last four years, it has been the most competitively priced biofuel in the world.



USDA has many years of experience in developing ethanol programs. There were many failures before success was achieved. Going forward, USDA wants to help other countries create or expand their own biofuels programs and is always available to provide data and experts to help countries avoid the mistakes made in the United States.

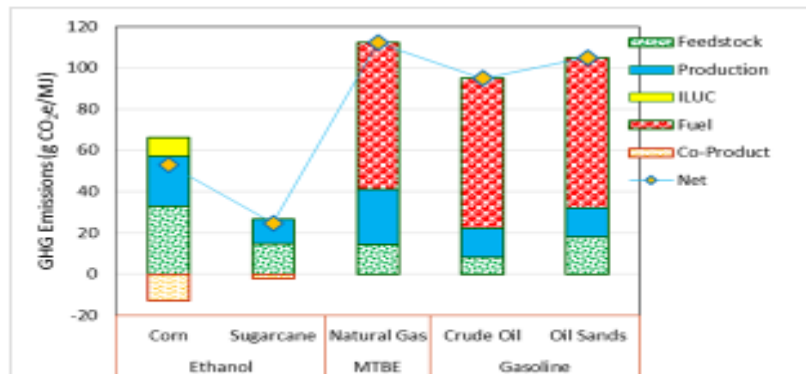
[Presentation #2: The Impact of Higher Ethanol Blend Levels on Vehicle Emissions in Five Global Cities](#)

Dr. Steffen Mueller, Principal Research Economist, University of Illinois at Chicago

Two environmental considerations related to the use of biofuels like ethanol are changes to tailpipe emissions and the greenhouse gas intensity of fuel use. The University of Chicago's Five Cities study looked at the impact of these changes in five international cities, including Seoul. Tail pipe emissions are a local pollution issue while greenhouse gas intensity is a global issue. Regardless of the life cycle emissions model used, a 10% blend ratio in Korea's gasoline transportation fuel would result in an immediate 4% to 6% greenhouse gas savings.

GHG Emissions

- Oxygenates can reduce GHG emissions
 - Low CI ethanol
 - Lower reformer severity



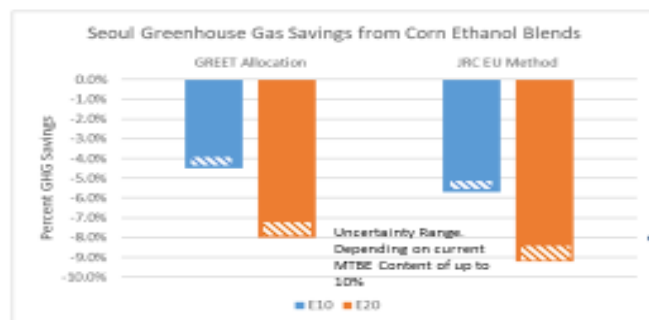
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With regard to urban air quality, the five cities studies found a 10% ethanol inclusion rate would immediately reduce concentrations of several pollution indicators in Seoul's air quality. Greater improvements are seen with higher inclusion ratios, especially in the category of "weighted toxins", those considered most harmful to human health. The human health impacts of biofuel inclusion are discussed in a later presentation by Angela Tin of the American Lung Association.



GHG Savings for Seoul/Korea

- On a total tonnage and percentage basis the study shows GHG reductions for Seoul
- EV Adoption: We looked at projected global EV Vehicle Stock Turnover which projected to be about 6% by 2027.
 - Ethanol adoption into the existing fleet provides about the same benefits **but right now.**



10% or 20% Ethanol Substituting for up to 10% MTBE

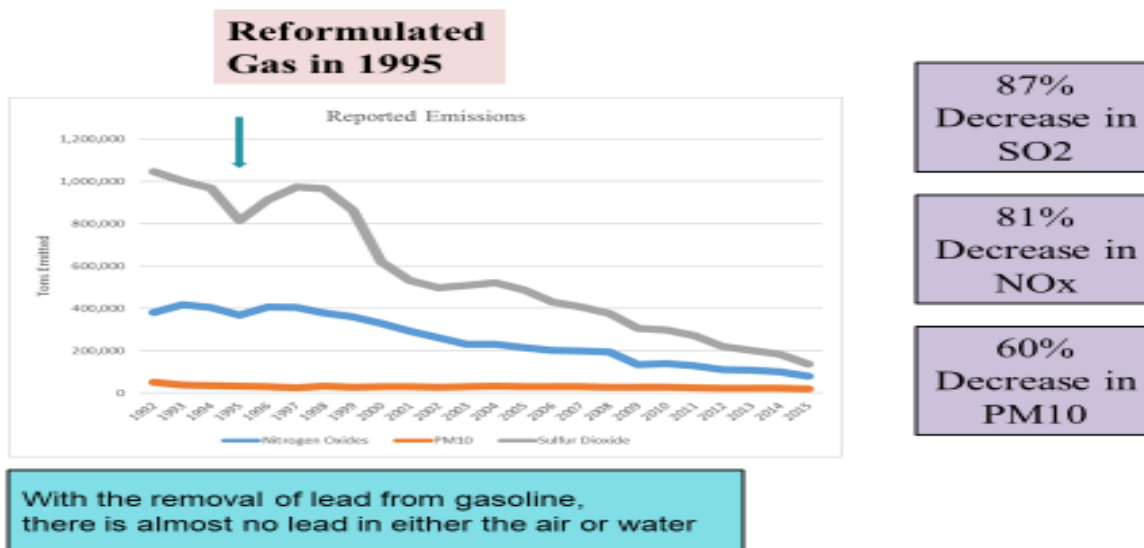
Regional Gasoline CI		GREET		JRC/Bioscience		MTBE	ETBE
Region	AV	85.15	85.80	85.80	85.80	7.8%	0.0%
Mexico City	MV	85.15	85.80	85.80	85.80	21.2%	0.0%
Seoul	AV	85.15	85.80	85.80	85.80	7.8%	0.0%
Seoul	MV	85.15	85.80	85.80	85.80	21.2%	0.0%

Enthaned Transport Distance (mi)		Mexico City		Seoul		Tokyo	
Mode	AV	1,000	1,000	1,000	1,000	1,000	1,000
Seoul		11,000	855	10,000	11,000	10,000	10,000
Truck		100	100	100	100	100	100

[Presentation 3: Clean Air Choice, Improving The Air We Breathe](#)

Angela Tin, Vice President, American Lung Association

Air pollution is one of the top causes of lung disease and cancer. To improve air quality, there are two proven solutions in the United States, which are to focus on engine operation and fuel components. This has been done by upgrading engine performance through mobile source standards and requiring the use of alternative fuel or alternative technology, which include reformulated gasoline with bio ethanol. Reformulated gasoline showed reduced harmful gasoline emissions as the table below:



Health benefits resulted from reformulated gasoline are as follows:

Health Benefits		
REFORMULATED GAS SUBSTANTIALLY REDUCES HARMFUL GASOLINE EMISSIONS		
2016 USDA Report Lifecycle Greenhouse Balance of Ethanol The Health Benefits of Ethanol: C. Boyden Gray		
Air Toxics		-28%
Volatile Organic Compounds		-17%
Nitrogen Oxides		-3%
Carbon Monoxide		-13%
Sulfur Oxides		-11%
Carbon Dioxide (Green House)		-4% (-30%) (43% - 76%)
Particulate Matter		-9% (-50% for fine PM)
Reduced Cancer Risk		-20 – 30%

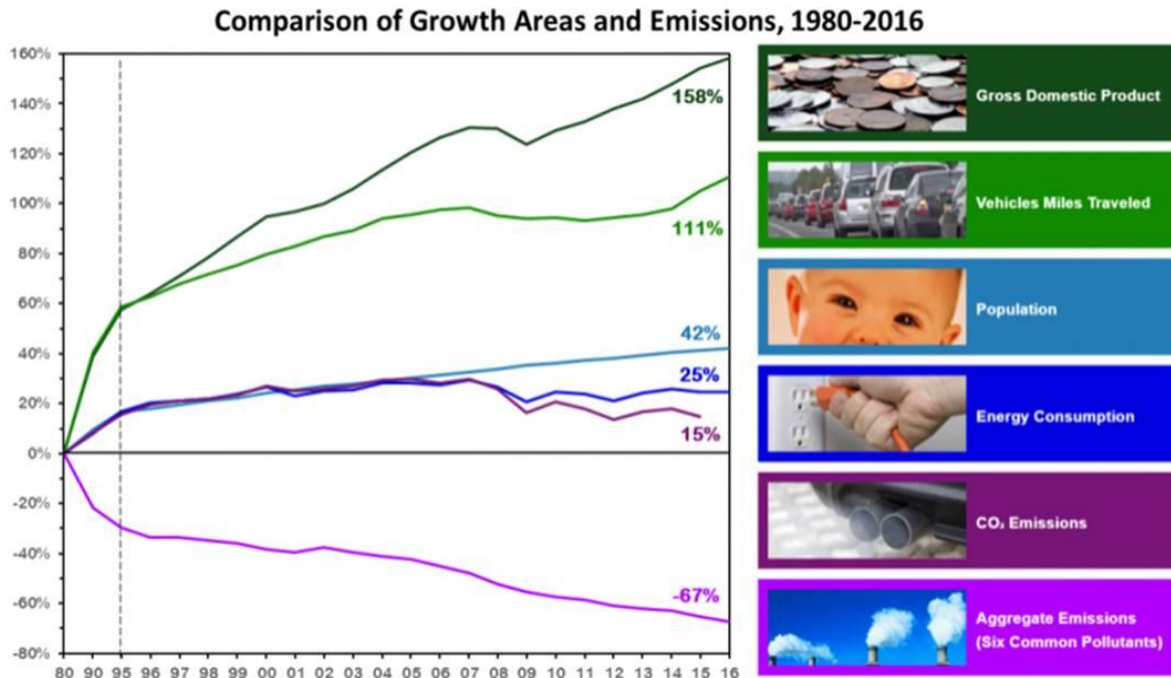
AMERICAN LUNG ASSOCIATION.

[Presentation 4: The United States Experience in Using Ethanol Fuels to Meet Clean Air Act Goals](#)

John Mooney, Chief, Air Programs Branch, U.S. EPA Region 5

The Clean Air Act is working; environmental improvement does not come at the cost of economic

development. In the United States, the economy and population have grown since 1980, but carbon dioxide and other pollutants under the Clean Air Act have decreased. A large percentage of current emissions are coming from mobiles. 62 percent of U.S. oxides of nitrogen (NOx) emissions come from mobiles, while 26 percent of U.S. hydrocarbons emissions are coming from mobiles.



There are a variety of gasoline programs across the United States. We have a number of fuel requirement programs that can be tailored to meet the air quality and economic goals for the region. There is not a 'one size fits all' program for the country. However, there is a 10 percent ethanol threshold throughout the United States. In the early 1990s, we started seeing problems with MTBE when reformulated gas was produced, this resulted in a national ban of MTBE. The Renewable Fuel Standard (RFS) has been in place since 2007. Based on the health benefits of ethanol, there was a push to have a renewable fuel standard to use certain amounts of ethanol each year. The Renewable Fuel Standard helps meet fuel security goals and air quality goals, supports domestic crops, and helps cut greenhouse gases.



Summary

- ▣ **The Clean Air Act has been successful in dramatically reducing air pollution in the United States.**
- ▣ **Reduction in pollution from all types of motor vehicles has been critical to meeting air quality goals.**
- ▣ **Regulation of motor vehicle fuels at the national level, combined with local fuel requirements has brought many areas to within health-based air quality standards.**
- ▣ **Use of oxygenates in fuels, primarily ethanol, has been an important component of fuels programs in the U.S.**
- ▣ **Ethanol will play a very strong role in national fuels programs in the future.**

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[Presentation #5: Biofuels and Fine Dust in Korea](#)

Dr. Bae, Jeong-Hwan, Chonnam University

As the Korean society has begun to take the air quality issue seriously in recent years, the Republic of Korea Government (ROKG) has established various mitigation policies such as reduction of old diesel cars, promotion of electric and hydrogen cars, restriction of old coal fired power plants, etc. However, the ROKG's policies in the transportation sector concentrate mainly on the promotion of hybrid electric cars due to the encouragement of domestic technology development.

Government policy on air pollution (fine dust)

- ▶ Major causes of fine dust
 - ▶ Yellow dusts from China explain 30-50% of total
 - ▶ Domestic sources: diesel cars take about 29% in the Seoul metropolitan areas, while pollution intensive plants take 41% in the other cities
- ▶ Reduction strategy on fine dust
 - ▶ Management of domestic sources: reduction of fine dust for diesel cars, promotion of electric and hydrogen cars, restriction of driving, suspension of old coal fired power plants, more stringent regulation on pollution intensive plants, promotion of vacuum cars
 - ▶ Promotion of new industry on fine dust and CO2 reductions: promotion of environment-friendly buildings and smart city, obligation of energy zero buildings, breeding of prosumers
 - ▶ Environmental cooperation with China and Japan
 - ▶ Innovation of alarm system
 - ▶ Personal excise tax exemption by 70% for replacing old diesel cars for hybrid or electric cars
- ▶ Environmental & Energy economists claim that distorted oil taxes worsen air pollution

Meanwhile, there is no government plan for bioethanol yet for gasoline cars, and only allows three percent of biodiesel blending for diesel cars in the transportation sector. For better air quality in transportation sector, the presenter suggested that the ROKG needs to improve the Korean RFS program, including bioethanol as well as biogas and others. In addition, the current biodiesel blending ratio should be increased to seven percent by 2022 and more investment is needed on second and third generation biofuel technology.

No concerns over biofuels in mitigation policy on fine dust

- ▶ Major transport policy concentrates on promotion of hybrid, electric cars
- ▶ Although biodiesel is effective in reducing PM10 and SOx, current RFS allows for 3% of BD
- ▶ BD5 is expected to be blended with diesel until 2023
- ▶ There is no government plan for bioethanol blending with gasoline in Korea
- ▶ Demonstration project on bioethanol (E3-E6 and bio-buthanol) is implemented by this year
 - ▶ This project test economic as well as technological feasibility of E3-E6 with bio-buthanol in Korea

How to improve RFS program in Korea?

- ▶ Bioethanol as well as biogas and others should be included in the RFS
 - ▶ Petroleum companies object to inclusion of bioethanol
- ▶ Higher blending ratios should be accounted for biofuels
 - ▶ By 2022, BD blending ratio is 7%!
 - ▶ As of 2013, USA average biofuel blending ratio is 9%
 - ▶ Major Southeastern countries have higher targets (BD10 - 20)
 - ▶ So, the maximum blending ratio should be at least up to 10%
- ▶ More investment on 2nd and third generation biofuel technology
 - ▶ R&D investment on biofuels from biomass, micro algae, and macro algae should be raised
 - ▶ But R&D supports as well as commercialization subsidy are not sufficient at present
 - ▶ There are no oil tax exemption subsidy on biofuels but no tax on electric cars!
 - ▶ More subsidy flows into electric or hydrogen fuel cell cars

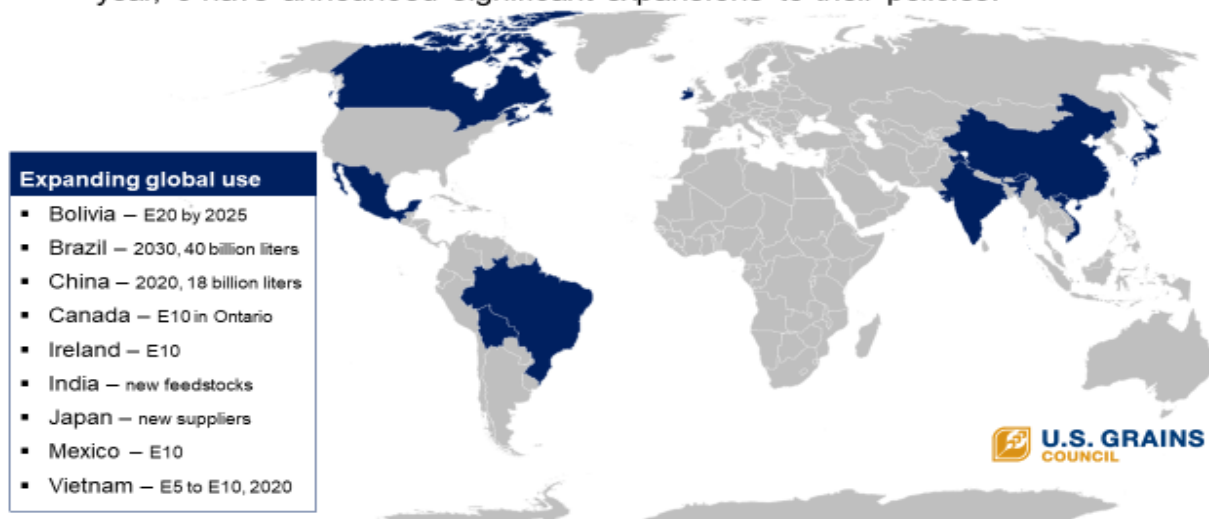
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Presentation #6: Growing Global Ethanol Use: Four factors driving Production, Consumption, and Trade

By Brian D. Healy/Manager of Ethanol Export Market Development/USGC

More than 60 countries have biofuels policies in place. In 2017, nine countries announced significant expansions to their policies, while Korea has not adopted bioethanol as a biofuel policy yet. Global production of bioethanol has already surpassed 100 billion liters in 2017, continuing its expansion due to a combination of four factors driving the use of ethanol such as 1) Agricultural producers and complementary industries; 2) Environmental benefits; 3) Human health benefits; and 4) Economics and profitability. Presenter explained that bioethanol could provide Korea with benefits of environment, human health and economics and profitability when Korea has bioethanol policies in place.

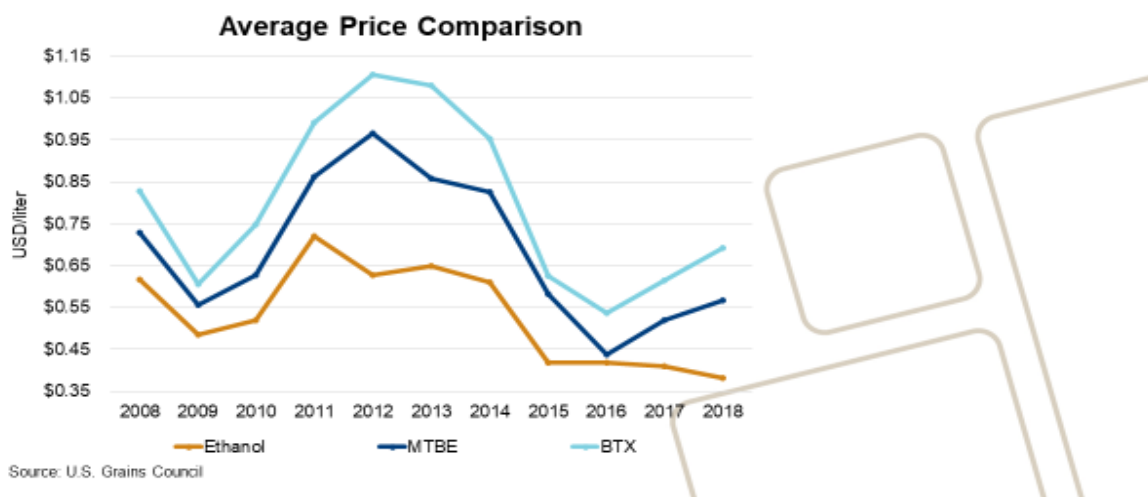
More than 60 countries have biofuels policies in place. In the last year, 9 have announced significant expansions to their policies.



Via the Paris Agreement, countries have dedicated themselves to reducing greenhouse gas (GHG) emissions. USDA assessed that U.S. corn ethanol reduces emissions by 43 percent over conventional gasoline in 2017, expecting to exceed 50 percent by 2022. There are also significant economic benefits to using biofuels. Conventional gasoline needs an oxygenate added. Korea adds MTBE, a substance banned in the United States and elsewhere due to groundwater contamination concerns. Ethanol is a cheaper oxygenate than MTBE. Gasoline with ethanol blends are typically cheaper to buy at the pump in the United States.

Consumers and profitability

Ethanol is cheapest source of octane over the last decade, holding significant economic advantages



The U.S. ethanol industry is building global biofuels partnerships with interested countries to avoid false starts in policy development and to share best practices in expanding the global use of ethanol. U.S. industry and government stand ready to support Korea in developing a policy with a role for trade. The Presenter recommended that E10 is starting point for new policy, which is essential level for Korea to enjoy of benefits of bioethanol.

Presentation 7: China's Fuel Ethanol Development, Policy and 2020 E10 Promotion Plan

Michael Mao, Senior Energy Analyst, International Business Unit, sublime China Information Co., Ltd.

China's ethanol industry development has come in three stages. First, from 2001-2005 was the 10th five-year plan period, which initiated the industry development. Next, from 2006-2011 was the 11-12th five-year plan period, which was a setback stage for the industry. Now is the 13th five-year plan period, (2016-2020) which is a reboot era. The government rebooted the ethanol industry for three reasons: agricultural development (helping deal with a bulge in production), environmental protection, and energy safety prevention.

Chinese fuel ethanol production is tightly managed by the government. Fuel ethanol production

qualification requires the approval of provincial Development and Reform Commission as the franchise, and the sales right is also fixed to Sinopec and CNPC. The trade flow of fuel ethanol in the domestic market is government's control, from franchised producers to franchised retailers. There are only 11 franchise producers and two franchise retailers. Fuel ethanol prices are fixed and adjusted by NDRC according to the gasoline wholesale price. State Owned Enterprises (SOEs) make up more than 50% of the franchised producers' capacity.

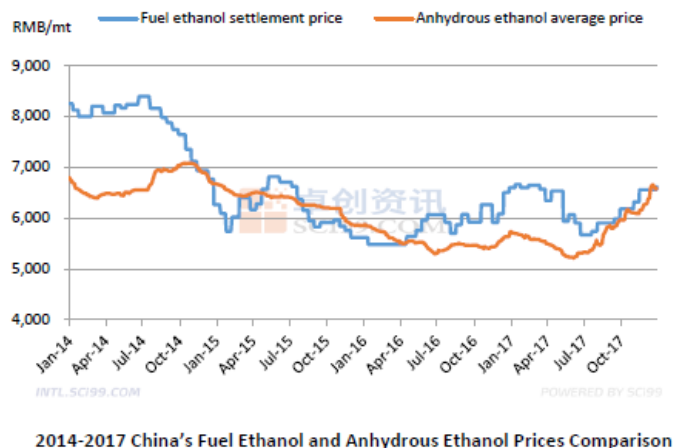
China's fuel ethanol capacity and output both remained stable from 2014 to 2016 due to restrictive policies and slow promotion. In 2017, the domestic demand grew, and fuel ethanol plants were actively producing. In 2017, capacity was around 3,400 kt, and output was around 2,250 kt. China's apparent consumption volume of gasoline in 2017 was around 122,223.9 kt. In China, the only usage of fuel ethanol is for gasoline blending in the ethanol gasoline market.

Ethanol has been brought into the trade conflict between the United States and China. On April 2, 2018, the tax was 45% on U.S. origin ethanol, but from July 6, 2018 this rate will rise to 70%.

The change in fuel ethanol price is positively correlated with refined oil prices and international crude oil prices because the price of fuel ethanol is linked to the refined oil price formulated by NDRC.

However, China's anhydrous ethanol prices are generally determined by supply, demand, and cost.

2020 E10 Promotion's Impact on Ethanol Price



- The price of fuel ethanol is not market-oriented, while it is linked to the refined oil price formulated by NDRC. Therefore, the change of fuel ethanol price also has a positive correlation with refined oil prices and international crude oil prices.
- China's anhydrous ethanol prices are generally determined by the supply-demand fundamentals and cost.
- Although the ethanol content of fuel ethanol was lower than that of anhydrous ethanol, the settlement prices of fuel ethanol were higher than the average price of anhydrous ethanol at the most time from 2014 to 2017. (The average price of anhydrous ethanol in the above chart was based on the three average prices in North Jiangsu, Jilin and Guangxi.) As a result of the unreasonable fuel ethanol pricing mechanism, as well as the difficult approval of fuel ethanol production qualification, the consumption volume of fuel ethanol occupied the most among the total anhydrous ethanol consumption of downstream industries.

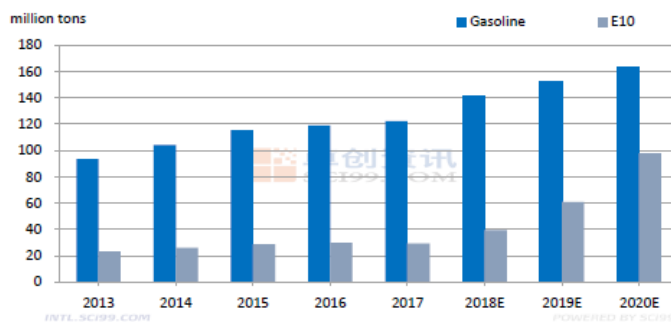
There are many new projects expanding the capacity for ethanol under planning in China. However, of the 11 franchise producers of ethanol in China, almost all are using corn. China's corn price peaked in 2014 due to the temporary purchase and reserve policy. Prices then crashed as the policies were terminated in the wake of saturated state reserves and social stocks. Meanwhile, cassava imports have been stagnant due to high prices.

After 2020, the volume of MTBE used to blend oil is projected to decline due to ethanol gas promotion. The promotion of ethanol gasoline is expected to overturn the MTBE industry.

China's ethanol gasoline promotion is projected to be slow in 2018. 2018 is likely to be a transitional period, as the government will make detailed plans and study the ethanol gasoline market instead of promoting it in a rush. The ethanol gasoline market will achieve more success from 2019 to 2022 or even further in the future.

China's Fuel Ethanol Outlook

Gasoline Consumption



China Gasoline Consumption Forecast

- SCI estimates China's ethanol gasoline promotion will be slow in 2018. Only 6 provinces achieved the closed management and operation of the ethanol gasoline in 2017, and only 7 provinces promoted the ethanol gasoline in some regions. Therefore, 2018 is more likely to be a transitional period, and the government will make detailed plans and study on the ethanol gasoline market instead of promoting it in a rush. The ethanol gasoline market will achieve obvious success from 2019 to 2022 or even in a further future.

[Presentation #8: U.S. Bioethanol Policy and Market Experience](#)

Jim Miller, President, Agriculture and Biofuel Policy Consulting

Ethanol has been around in the United States for a long time, starting with the beginning of the automobile industry. The U.S. biofuels program currently has several program priorities, including environmental benefits, energy security, and the development of future biofuels technology. The below slide contains a brief history of the U.S. biofuel situation.

A Brief History

- Model T - First flex-fuel vehicle
- Prohibition (1920 - 1933) - Established fossil fuel monopoly
- Introduction of Tetra-ethyl lead in 1920's - octane to reduce engine knock
- Phase-out of lead as human health hazard - 1970's
- Alternative octane sources: Aromatics, MTBE, Ethanol
- U.S. Clean Air Acts - Established oxygenate and vapor pressure requirements
- MTBE oxygenate of choice - fossil fuel products, readily available, inexpensive
- Beginning in 2002 states began banning MTBE due to groundwater pollution
- 25 states had bans in place by 2007
- Ethanol became replacement oxygenate and octane enhancer
- Renewable Fuel Standards established enforceable targets for blending biofuels
- Achieved effective 10% blend-rate in 2016
- Expansion of higher blend market occurring currently (E15)

There are several factors driving demand for ethanol around the globe. The below slide highlights these factors.

Global Opportunities: Potential New Markets Over 10 Years

- **Primary focus is on Asia Pacific region & the Americas:**
 - Ethanol usage is generally low globally
 - Fuel consumption growth is the fastest in the world.
 - Air quality problems are widespread and worsening
- **Mitigating GHG emissions has become increasingly important after COP-21 in Paris.**
 - New opportunities for fuel ethanol from all feedstocks.
 - New Life Cycle Analysis from US Department of Agriculture shows large improvement in GHG profile of corn ethanol over the past decade. Likely to exceed average 50% reduction vs gasoline within five years.
- **Octane advantages of ethanol blending.**
 - Gasoline refiners, blenders and consumers could benefit from a full cost/benefit analysis of ethanol.
 - Increasing concern about the impact of MTBE on groundwater
 - Displacing aromatics, which comprise 25-40% of gasoline to boost octane offer economic/environmental/health gains.

At the same time, expansion of ethanol usage faces challenges. These are:

Challenges

- ▶ **Opposition from oil industry / others**
- ❖ **Renewable fuel policies: inconsistent enforcement, low blend rates**
- ❖ **Infrastructure:**
 - Feedstock/refining capacity, import capacity, domestic blending/transportation capacity
- ❖ **Differing policies, laws, regulations - need for harmonization**
- ❖ **Exchange rates / foreign exchange**
- ❖ **Rise of trade protectionism**
 - Import limitations, administered prices, tariffs, AD/CVD, non-tariff trade barriers
- ❖ **Product Specifications**

If a country can commit to an enforceable biofuels policy, there are several benefits:

Benefits of Policy, Enforcement & Trade

Achieve Policy Goals Sooner:

- Market certainty - investment, supply, risk management
- Reduces fossil fuel dependence
- Ethanol blending benefits - environment, health
- Value proposition - reduce blend stock costs, ethanol v. aromatics/MTBE, value of octane
- Consumer benefits of lower prices and fuel choices

[Presentation #9: Prospect for Market Expansion of Bioethanol In Korea](#)

Dr. Sang, Byoung-In, Professor of Hanyang University

Korea provides biodiesel in the transportation sector with three percent mandatory blending into the diesel fuel under the current Korea Renewable Fuel Standard (RFS) program. Despite a strong request for higher blending ratio by domestic biodiesel producers, the biodiesel blending ratio will be reviewed in 2020. Meanwhile, bioethanol for gasoline cars is not commercialized yet in Korea, while neighboring countries such as China and Japan are already commercialized in the transportation sector in the form of E10 in China and ETBE in Japan. The presenter also suggested a possible biofuel roadmap that Korea

needs to include bioethanol in the Korean biofuel portfolio as soon as possible for the environmental benefits including the reduction of greenhouse gas emission. The presenter pointed out that Korea needs to secure some portion of domestic feedstock for the biofuel production to expand current biofuel market.

Country	Current mandate/target	Current status	Future and date/target (2020)
China	E10 (9 rovinces), B5	M	E10 (9 provinces), E15 (T)
Korea	B2.5	M	B3 (2018)
Japan	ETBE, B5	T	10% biofuels (2030)
United States	9.02% renewable fuels B: 68.5 billion litres	M	136 billion litres biofuels by 2022

Introduction strategy of bio-alcohol

